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Development of MASC Sensor Carrier

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Abstract

At the Universtity of Tübingen, Germany, a UAS named Multipurpose Automatic Sensor Carrier (MASC) was developed to carry a large variety of meterological in situ and optical sensors. First tasks of MASC include the measurement of turbulent fluctuations of temperature, humidity and wind vector in the lower troposphere (up to 2000 m) in order to calculate turbulent energy and momentum fluxes as well as vertical profiles for direct comparison with remote-sensing techniques. Beside atmospheric physics, several geo-physical applications are possible i.e. the observation of the earth surface and vegetation in the visible, infra-red and near infra red range.

During the development special care was taken to set up a system with a small package size, automatically connecting wings and control surfaces. The small aircraft can carry large payload, has an universal ability of payload mounting and very low landing speed. For cost reduction the whole aircraft is build in an innovative vacuum bagging technique. MASC has a very low take off weight putting the long flight endurance in respect. The wing is speciallly designed with the XFLR5 code and extra airfoils have been designed for the aircraft. In this way a glide ratio of 30 is nearly reached with a small aircraft at a cruise speed of 20 m/s. Due to the two fuselage concept of MASC, a bungee takeoff can be made safely by one operator and an autonomous takeoff is easily possible. The radio control system is redundant with four seperate receiver channels used to provide secure RC transmission. The payload is designed in a seperate body and and is independent from the aircraft itself, data logging and sensors are part of the payload. This fact allows the quick adaption of all kinds of payload up to 2.5 kg. The vaccum bagging technique is normally used for extrem lightweight model aircraft structures. This technique, which was slightly modified for MASC, allows for low-cost and very precise wing and elevator parts, without using very expensive moulds. For the fuselages a modified carbon kevlar covered balsa box structure was used, this provides flexible, fast built and very stiff fuselage structures. In the main wing a fowler system is used to provide very low landing speed. The airfoils of wing and tails are specially designed for very safe handling without lack of performance considering usual airfoils. All aerodynamic design was made with the XFLR5 program that provides, very accurate results and has an X-Foil programm integrated. Laminar separation bubbles were minimized by several design optimizations. Also dynamic stability analysis was made with this program to optimize the dynamic control behaviour. Two 2.4 Ghz 2-channel recceivers are connected via a bus system to avoid the loss of the aircraft due to receiver failure. The receivers are integrated each in one fuselage which provide stable bungee takeoff without the need for additional staff. In this talk, we give a summary of all innovative details, that were made during the development of MASC and a short outlook on further improvements.